

CLAIMS:

1. A liquid electrophotographic toner composition comprising:

5           a) a liquid carrier having a Kauri-butanol number less than 30 mL; and  
b) a plurality of toner particles dispersed in the liquid carrier, wherein the toner  
particles comprise polymeric binder comprising at least one amphipathic copolymer  
comprising one or more S material portions and one or more D material portions, wherein  
the toner composition comprises acidic and basic functionality in an amount sufficient to  
10 provide a three dimensional gel of controlled rigidity which can be reversibly reduced to  
a fluid state by application of energy; and wherein the electrophotographic toner  
composition does not form a film under Photoreceptor Image Formation conditions.

2. The liquid electrophotographic toner composition according to claim 1, wherein  
15 the acidic functionalities and basic are provided on one amphipathic copolymer.

3. The liquid electrophotographic toner composition according to claim 2, wherein  
one of the acidic or basic functionalities are located in the S material portion, and the  
corresponding acidic or basic functionalities needed to form the acid/base pair is located  
20 in the D material portion.

4. The liquid electrophotographic toner composition according to claim 3, wherein  
the acidic functionalities are located in the S material portion, and basic functionalities  
are located in the D material portion.

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5. The liquid electrophotographic toner composition according to claim 3, wherein  
the basic functionalities are located in the S material portion, and acidic functionalities  
are located in the D material portion.

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6. The liquid electrophotographic toner composition according to claim 1, wherein  
one of the acidic or basic functionalities are located on a first amphipathic copolymer,

and the corresponding acidic or basic functionalities needed to form the acid/base pair is located on a second amphipathic copolymer.

7. The liquid electrophotographic toner composition according to claim 6, wherein  
5 the acidic or basic functionalities located on the first amphipathic copolymer are located on the S material portion of the first copolymer, and the acidic or basic functionalities located on the second amphipathic copolymer are located on the S material portion of the second copolymer.
- 10 8. The liquid electrophotographic toner composition according to claim 6, wherein  
the acidic or basic functionalities located on the first amphipathic copolymer are located on the D material portion of the first copolymer, and the acidic or basic functionalities located on the second amphipathic copolymer are located on the D material portion of the second copolymer.  
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9. The liquid electrophotographic toner composition according to claim 6, wherein  
the acidic or basic functionalities located on the first amphipathic copolymer are located on the S material portion of the first copolymer, and the acidic or basic functionalities located on the second amphipathic copolymer are located on the D material portion of the  
20 second copolymer.
10. The liquid electrophotographic toner composition according to claim 6, wherein  
the acidic or basic functionalities located on the first amphipathic copolymer are located on both the S material portion and the D material portion of the first copolymer, and the  
25 acidic or basic functionalities located on the second amphipathic copolymer are located on both the S material portion and the D material portion of the second copolymer.
11. The liquid electrophotographic toner composition according to claim 1, said  
composition comprising a polyfunctional bridging compound having at least two acidic  
30 or basic functionalities to assist in gel formation.

12. The liquid electrophotographic toner composition according to claim 1, wherein one of the acidic or basic functionalities are located on an amphipathic copolymer, and the corresponding acidic or basic functionalities needed to form the acid/base pair is located on a polyfunctional bridging compound.

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13. The liquid electrophotographic toner composition according to claim 12, wherein acidic functionalities are located on the amphipathic copolymer, and at least two basic functionalities are located on a polyfunctional bridging compound.

10 14. The liquid electrophotographic toner composition according to claim 12, wherein basic functionalities are located on the amphipathic copolymer, and at least two acidic functionalities are located on a polyfunctional bridging compound.

15 15. The liquid electrophotographic toner composition according to claim 1, wherein acidic functionalities are provided by incorporation of one or more acid-functional polymerizable compounds in the amphipathic copolymer, wherein the acid-functional polymerizable compound is selected from the group consisting of acrylic acid, 2-acrylamido-2-methyl propane sulfonic acid, crotonic acid, itaconic acid, maleic acid, methacrylic acid, pentaerythritol dimethacrylate, 2-carboxyethyl acrylate, styrene  
20 sulfonic acid, and 4-vinyl benzoic acid.

16. The liquid electrophotographic toner composition according to claim 1, wherein basic functionalities are provided by incorporation of one or more base-functional polymerizable compounds in the amphipathic copolymer, wherein the base-functional polymerizable compound is selected from the group consisting of 2-(dimethylamino)ethyl methylate, diacetone acrylamide, acrylamide, allyl alcohol, allyl amine, allyl diethylamine, allyl ethylamine, allyl dimethylamine, allyl hydroxyethyl ether, N-allyl piperidine, p-amino styrene, diallyl amine, bis-diallylmino methane, t-butylamino methacrylate, diethylaminoethyl methacrylate, diallyl methylamine, N,N-30 diallylmelamine, 2-dimethylaminoethyl methacrylate, dimethylaminopropyl acrylamide, 2-dimethylamino methyl styrene, 3-dimethylamino neopentyl acrylate, 2,3-dihydroxy

propyl acrylate, 2-diisopropylaminoethyl methacrylate, 4-hydroxybutyl acrylate, 4-hydroxybutyl methacrylate, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, 2-hydroxypropyl acrylate, 2-hydroxypropyl methacrylate, 4-hydroxy styrene, vinyl benzene alcohol, vinyl benzene dimethylamine, 2-vinyl pyridine, 4-vinyl pyridine, and N-vinyl-2-pyrrolidone.

17. The liquid electrophotographic toner composition according to claim 1, wherein the D material portion of the amphipathic copolymer has a total calculated  $T_g$  greater than or equal to about 30°C.

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18. The liquid electrophotographic toner composition according to claim 1, wherein the D material portion of the amphipathic copolymer has a total calculated  $T_g$  of from about 50-60°C.

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19. The liquid electrophotographic toner composition according to claim 1, wherein the amphipathic copolymer has a total calculated  $T_g$  greater than or equal to about 30°C.

20. The liquid electrophotographic toner composition according to claim 1, wherein the amphipathic copolymer has a total calculated  $T_g$  greater than about 55°C.

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21. The liquid electrophotographic toner composition according to claim 1, the toner particle comprising at least one visual enhancement additive.

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22. A method of making a liquid electrophotographic toner composition, comprising the steps of:

a) providing a plurality of free radically polymerizable monomers, wherein at least one of the monomers comprises a first reactive functionality;

b) free radically polymerizing the monomers in a solvent to form a first reactive functional polymer, wherein the monomers and the first reactive functional polymer are soluble in the solvent;

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c) reacting a compound having a second reactive functionality that is reactive with the first reactive functionality and free radically polymerizable functionality with the first reactive functional polymer under conditions such that at least a portion of the second reactive functionality of the compound reacts with at least a portion of the first reactive functionality of the polymer to form one or more linkages by which the compound is linked to the polymer, thereby providing an S material portion polymer with pendant free radically polymerizable functionality;

d) copolymerizing ingredients comprising (i) the S material portion polymer with pendant free radically polymerizable functionality, (ii) one or more free radically polymerizable monomers, and (iii) a liquid carrier in which polymeric material derived from ingredients comprising the one or more additional monomers of ingredient (ii) is insoluble;

said copolymerizing occurring under conditions effective to form an amphipathic copolymer having S and D portions and to incorporate acidic or basic functionality in the copolymer, the toner composition comprising acidic and basic functionality in an amount sufficient to provide a three dimensional gel of controlled rigidity which can be reversibly reduced to a fluid state by application of energy; and wherein the electrophotographic toner composition does not form a film under Photoreceptor Image Formation conditions.

23. The method of claim 22, wherein the first reactive functionality is selected from hydroxyl and amine functionalities, and the second reactive functionality is selected from isocyanate and epoxy functionalities.

24. The method of claim 22, wherein the first reactive functionality is a hydroxyl functionality, and the second reactive functionality is an isocyanate functionality.

25. The method of claim 22, wherein the first reactive functionality is selected from isocyanate and epoxy functionalities, and the second reactive functionality is selected from hydroxyl and amine functionalities.

26. A method of electrophotographically forming an image on a substrate surface comprising steps of:

- a) providing a liquid toner composition of claim 1;
- b) causing an image comprising the toner particles in a carrier liquid to be formed on a surface of a photoreceptor; and
- c) transferring the image from the surface of the photoconductor to an intermediate transfer material or directly to a print medium without film formation on the photoreceptor.